DOCUMENT RESUME

ED 153 201 CS 004 045

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TITLE The Use of Detail and Background in Visuals and Its Effect on Learner Achievement and Attitude.
PUB DATE Mar 78
NOTE 15p.; Paper presented at the Annual Meeting of the American Educational Research Association (Toronto, Canada, March 1978)

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Audiovisual Instruction; *Complexity Level; Educational Research; Effective Teaching; *Illustrations; Military Personnel; Military Training; *Pictorial Stimuli; *Technical Education; Training Techniques; *Visual Stimuli

ABSTRACT

Eighty soldiers with the same appropriate occupational specialty (armor crewman) were randomly assigned to either a simple or a complex audiovisual lesson format to determine the effect of visual art on mastery of instructional material. The audio parts of the two versions were identical, but the visual art on the revised filmstrip was simplified by removing background, removing uniform details from soldiers, or sketching equipment rather than drawing it to scale. A pretest established whether subjects had prior knowledge of lesson content. After the lesson, all subjects completed two posttests: lesson content and an attitude scale. Data were analyzed using ANCOVA with GT scores (composite army aptitude test scores) and pretests as covariates, and with posttests and attitude scales scores serving as dependent variables. Results suggest that complex art in audiovisual lessons contributes nothing to either the soldier's learning or to their attitudes toward the lessons. (RL)

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The Use of Detail and Background in Visuals and Its Effect on Learner Achievement and Attitude *

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*Paper presented at the 1978 annual meeting of the American Educational Research Association, Toronto, March 1978.

CS004405

ABSTRACT

The goal of this research was to determine whether subjects completing a simplified version of a tape - filmstrip lesson would differ in achievement or attitude from comparable subjects who completed a more complex version of the same lesson.

Both lessons were in the conventional audiovisual format used for most TEC lessons developed by the U.S.Army. The audio part of the two versions was identical but the visuals on the revised filmstrip were simplified by such changes as removing background, removing uniform details from soldiers, and sketching equipment rather than drawing it to scale.

Eighty soldiers with the appropriate specialty were randomly assigned to simple and complex treatments. A pretest was given to estimate prior knowledge of the lesson content. After treatment, all subjects were administered two post tests dealing with lesson content and an attitude scale. The data were analysed using ANCOVA with GT score and pretest used as covariates and post tests and attitude scores used as dependent variables. None of the differences between the two treatment groups was statistically significant. Chi Square was used to analyse the individual attitude items. Only one item yielded a significant result, which favored subjects who were in the simple lesson treatment.

THE PROBLEM

This study was designed to determine whether the use of complex visual art which represents equipment to scale and human figures in great detail is more effective than simple visual art in terms of the content mastery and attitudes of individuals who are taught with these visuals.

In 1972, the US Army Combat Arms Training Board initiated the development of TEC lessons. The first TEC lesson was ready for field use in 1974. There are currently 395 TEC lessons in the field including 322 that employ the audiovisual format studies in this research. This work is currently being carried on by the US Army Training Support Center at Fort Eustis, Virginia. The typical TEC lesson includes a filmstrip cassette and an audio cassette that are designed for use in the BESSELER Cue-See projector. In this research a TEC lesson was selected which included a large percentage of complex visuals. These visuals were then examined carefully and a parallel set of simpler visuals was prepared. The main concern of this study was to compare the achievement and attitudes of comparable subjects who were trained using the simple and complex lessons.

The study was designed to test the following null hypotheses:

1. There will be no significant difference in the achievement of subjects who are taught the same concepts using two sets of visuals which differ in detail, complexity, accuracy of scale, and use of background.

2. In comparing subjects who have taken the two lesson variations, there will be no significant differences in their attitudes toward the visual aspects of the specific lessons or with respect to their perceived effectiveness of the TEC lesson format.

PREVIOUS RESEARCH

The justification for using large amounts of realistic detail in visual illustration is found in the theoretical work of Morris (1946) Carpenter (1953) and Dale (1954). Although differing considerably in detail, these various theoretical orientations can all be classified as realism theories (Dwyer, 1972). The basic assumption underlying all of these theories is that learning will be more complete as the number of cues in the learning situation increases. Therefore, an increase in realism in the visual portion of the TEC lessons would increase the number of cues in the learning situation and consequently should increase the probability that learning will be facilitated.

A review of research in this field, however, indicates that very few studies have been conducted which investigate the relative effectiveness of visual illustrations that employ different amounts of realistic detail and are used to complement oral instruction as is the case in the TEC lesson format. Two important early studies (Carpenter, 1954; Lumsdaine, 1958) employed filmgraphs to study simple versus complex motion picture film presentations. A filmograph is a simplified version of a motion picture film which is produced by using a motion picture camera to film either a series of still frames taken from the original motion picture or to film the storyboard from which the original motion picture was produced.

Carpenter (1954) prepared two filmographs from a sound motion picture film concerned with riot control for military trainees. One filmograph was based upon frames of the original motion picture while the other was shorter and was based on stock photographs which were substituted for complex mob scenes. Achievement gains and attitudes of subjects seeing the motion picture and the two filmographs were about the same. Carpenter concluded that simplified visual presentations in the motion picture format were about as effective as more complex ones. Lumsdaine's (1958 findings with different content were essentially the same as Carpenter's.

Gorman (1973) employed two black and white slide presentations to study the effects of pictorial detail on concept formation. One set of slides employed simple line drawings while the other sets employed detailed drawings. He developed a standardized set of instructions to employ in the treatments. He selected 150 5th, 9th, and 15th grade students for subjects in his study. There were no significant differences in the final performance of any of his groups.

Spaulding (1956) studied the performance of poorly educated adults in several developing countries and found that they had difficulty in interpreting complex illustrations. He concluded that pictorial complexity may reduce the "readability" of a picture in much the same way that idea density reduces the readability of printed material.

Wicker's (1970) research on paired-associate learning and the work of Paivio, Rogers, and Smythe (1968) concerned with free recall found that detailed pictures did not significantly improve learning as compared with simple line drawings.

Perhaps the most significant work in this area is a series of studies carried out by Dwyer (1972). In work that is closely relevant to the TEC lesson format, Dwyer developed a 2000 word instructional unit describing the human heart, its parts and the internal processes occurring during the systolic and diastolic phases. He then developed illustrations at different levels of complexity ranging from simple line drawings in black and white to realistic heart photographs in color. The 2000 word instructional unit was analyzed to locate critical information that could be illustrated in a visual treatment. Thirty-nine critical areas were identified and visuals were designed specifically to illustrate the information in each critical area. The end result was eight complete visual sequences reproduced on 2 x 2 slides. Four of these sequences were in black and white and four were in color. All sequences employed the same 2000 word instructional content recorded on audiotape. Care was taken to be sure that the same format and size relationships that appeared in the original heart photographs were conveyed in the drawings. The same set of printed symbols was used in all experimental treatments and these were positioned in identical locations on each slide. A control treatment employed the audiotape with no visuals.

In order to determine which treatment was most effective in facilitating student achievement of specific educational objectives, four criterion measures were developed. These involved drawing, identification, terminology, and comprehension. Students were permitted to take as much time as was required to complete one criterion measure before proceeding to the next. The measures contained 18 to 20 items each and had reliability coefficients ranging from .76 for the comprehension test to .81 for the drawing test. The total criterion test consisting of the four individual tests contained 78 items and had a reliability coefficient of .91.

Three of Dwyer's studies are directly relevant to our research. In all three studies, subjects were randomly assigned to treatment and results were analysed using analysis of variance or analysis of covariance, depending on initial group differences. Each subject received a pretest, participated in his respective instructional treatment and was administered four individual criterion tests.

In Dwyer's initial study the control treatment, plus three black and white presentations were used. A sample of 108 college freshmen were randomly assigned to four treatment groups. In comparing the performance of the

Four groups on the criterion measures it was found that the simple line drawing presentation was most effective for the drawing test, the identification test, and the total criterion score. The oral presentation (no visuals) was most effective for the terminology test and the comprehension test. Dwyer found that the more realistic illustrations i.e., shaded drawings and realistic photographs, were the least effective in complementing the oral instruction. In fact, they were no more effective than the oral instruction alone. Dwyer suggests that an undue amount of emphasis has been placed on the desirability of more realistic illustrations for instructional purposes.

In Dwyer's next study the nine treatments were administered to 1054 students in grades 9, 10, 11, and 12. At each grade level, each of nine classes was assigned at random to one of the treatment groups. A total of 20 comparisons were made to identify the most effective treatment for each criterion measure at each grade level. (see Table 1).

Table 1. Presentations Most Effective in Facilitating Immediate Retention on Each Critical Test for the High School Studies*

	Instructional Treatments			
Critical Measures	Ninth Grade	Tenth Grade	Eleventh Grade	Twelfth Grade
Drawing Test	II	II	II	I
Identification Test	II	II	II	V
Terminology Test	IV	III	I	IV
Comprehension Test	I	V	I	IV
Total Criterial Test	II	II	II	IV

Treatment I: Oral presentation
Treatment II: Simple line drawing presentation (b & w)
Treatment III: Simple line drawing presentation (color)
Treatment IV: Detailed, shaded drawing presentation (b & w)
Treatment V: Detailed, shaded drawing presentation (color)

Of these 20 comparisons it will be noted that in four cases the simple oral presentation with no visuals was most effective. Treatment 2, the simple line drawing presentation was most effective in nine of the 20 comparisons. Treatment 3, the simple line drawing presentation in color was most effective in one comparison. Treatment 4 was most effective in four comparisons, while treatment 5 was most effective in two comparisons. It will be noted that the four most realistic treatments i.e., 6 through 9 were not the most effective in any of the 20 comparisons.

*This table has been reprinted by permission from page 25, Francis M. Dwyer, A guide for improving visual instruction. State College Penna.: Learning Service, 1972.

In Dwyer's third study 261 college students were randomly assigned to the nine treatment groups. Students in each treatment group received identical oral treatment that was presented by tape recorder. Each treatment was presented in the same amount of time. Comparison of achievement on the five criterion measures indicated that the simple line drawing treatment in color was most effective for the total criterion test. For the four specific criterion measures the simple line drawing in black and white was most effective for the drawing test, the detailed shaded drawing for the identification test, and the oral presentation with no visuals for the terminology test and comprehensive test.

When we consider the overall results of Dwyer's three studies we find that the simple line drawing presentations emerged as the most effective on the total criterion measure. The four most complex treatments which consisted of black and white and color photographs of heart models and of actual hearts were the least effective.

These results seem to raise serious questions about the value of employing highly detailed, complex illustrations in comparable audiovisual lessons. However, the content to be learned in the previous studies that we have discussed has differed considerably from the typical content included in TEC lessons. Also, much of the previous research has been carried out with school children rather than with adults. Therefore, it appeared that a carefully controlled study was needed which would employ an actual TEC lesson and would involve subjects from a typical TEC lesson target audience, in order to provide cost effectiveness data that could be weighed in future TEC lesson development.

PROCEDURES

Sample

The target population for this research was Armor Crewmen (primary MOS 11e). A total of 80 subjects with this primary MOS were randomly assigned to four groups. Two of these groups, one morning and one afternoon, were administered the complex version of the selected TEC lesson while two other groups were administered the simple version.

Measures

The GT score, a composite army aptitude test score, was available on 79 of the 80 subjects. A 36 item pre-test was administered to all subjects prior to treatment. This pre-test dealt with the specific content covered in the selected TEC lesson, and consisted of 30 multiple choice items and 6 short answer items. The Coefficient of Internal Consistency of this measure (correct with the Spearman-Brown Prophesy formula) was found to be .80.

Three post treatment measures were administered to the subjects. The first was a 36 item post test that closely paralleled the pre-test in terms of item content although the specific items employed in the two forms were different. This measure had a Coefficient of Internal Consistency of .81. The second post measure, called the Visual Achievement Test, consisted of seven items. Learners were given seven photographs of the coax machinegun,

the topic of the TEC lesson, and were asked questions which referred to these photographs, such as: "Using picture 38, write down the letter that points to the safety switch on the machine gun." This measure had a Coefficient of Internal Consistency of .57. This low reliability was probably due to the small number of items included. The third post treatment measure was a 17 item questionnaire. Six of the items on this questionnaire were designed to sample the attitudes and opinions of the subjects with regard to their general evaluation of the lesson. A composite score on these items will be identified as the general attitude score. The questionnaire also contained eight items which were concerned with specific aspects of the visuals employed in the lessons. Three items on the attitude scale could not be incorporated into the two aforementioned composite scores and were analyzed separately.

The Treatments

The treatments that were employed in this experiment consisted of two forms of TEC lesson 020-171-5352-F entitled, Bore Sighting the Machineguns, M60/M60A1 Tank. The complex version of this lesson was the original lesson which is currently in operational use. It consists of an audio tape cassette plus 113 visuals connected in a filmstrip. These visuals include nine classified as simple artwork, 34 classified as standard artwork and 70 classified as complex artwork, using the Army's definitions. In order to develop a simpler version of this lesson, the investigators analyzed each frame in the complex lesson and prepared specificaions for simplifying most of the frames. This process resulted in 38 simple frames, 59 standard frames and 16 complex frames 59 standard frames and 16 complex frames.

Since the purpose of the study was to compare two lessons that differed only in degree of complexity, the investigators avoided all changes in the slides that would improve the slide rather than merely simplify it. For many of the slides, changes could have been made, that would probably have improved effectiveness. Much of the simplification involved removing superfluous items such as folage in the foreground and mountains, trees, etc. in the background, removing hands from the equipment, removing uniform details from soldiers in the frames and sketching equipment rather than drawing it to scale. Although the two versions of the lesson are far less different than the extremes of Dwyer's eight audiovisual treatments, they still represnet a significant difference in production requirements. Since the simple lesson was developed from the complex lesson, it is not possible to assertain where the optimum degree of simplification might lie. It seems likely, however, that further simplification built into the original production design would produce equivalent if not superior learning results to those found in this study. Both lessons employed the same audiotape and required the same time to complete, about 45 minutes.

Each treatment was carried out with two groups of 20 subjects. One group in each treatment was given the lesson in the morning and the other in the afternoon. This permitted the investigators to check the effects of time-of-day in addition to the effects of the two treatments.

RESULTS

Analysis of covariance was employed to analyze the results of this study. The GT score and pre-test score were employed as covariates while the post test score, visual score, and the two attitude scores were employed as the dependent variables. None of the adjusted F tests for treatment, time of day, or treatment and time interaction were statistically significant (See Table 2). The F ratios were all very small, ranging from .08 to 2.9. An F ratio of 3.97 would have been needed to reach statistical significance at the .05 level. The largest F ratio of 2.9 was found between the morning versus afternoon scores on the visual test. It will be noted in Table 2 that the students in both the simple and complex treatments who took the visual test in the afternoon obtained slightly higher mean scores. For all four of the dependent variables the differences between the adjusted final mean scores for subjects in the simple versus complex treatments were extremely small (Table 2).

In addition to the analyses of covariance on the two attitude scores, a Chi-Square analysis was made for sixteen items on the attitude questionnaire, comparing the response patterns of subjects in the simple and complex treatments.* Only item 10, "Did you find any mistakes on the pictures or sound?", showed a significantly different pattern of responses for the two treatment groups. Subjects in the simple lesson treatment gave more favorable responses than subjects in the complex lesson treatment. The Chi Square values for an additional five items approach significance, while response patterns for the remaining items were similar for the two treatments (See Table 3).

For all of the attitude items, the responses of both treatment groups were strongly favorable. This suggests that the TEC lesson format is preceived very positively by the great majority of subjects in the target group.

CONCLUSIONS AND RECOMMENDATIONS

The results of this study suggest that the use of complex art in the TEC lesson visuals contributes nothing either to the learning of soldiers in the target audience or to their attitudes concerning TEC lessons in general or the lesson they had just completed in particular. Although the results of this study apply more directly to some TEC lessons than others, when these results are considered along with other research in which a variety of different types of instructional material has been employed, it seems doubtful that the complex lesson format would be superior for any content that is likely to be covered in TEC lessons. In fact, Dwyer's work (1972) would suggest that if the investigators in this study had taken a more extreme approach and produced a greatly simplified set of TEC lesson visuals, the results might actually have favored the very simple version as opposed to the complex version currently in use.

*Item 16 was a free response item and could not be analysed using Chi Square.

In view of the results of this research, the following recommendations appear to be justified:

1. In the development of future TEC lessons as high a percentage of simple art as possible should be employed.

2. Additional research should be carried out in which lessons using very simple artwork are compared with the complex art currently being used in TEC lessons that are in the field. The simple art versions in this research should go as far towards simplification as the US Army Training Support Center and the cooperating Technical Schools are willing to accept. It would probably be desirable to classify current TEC lessons into several categories depending on the nature of their content and the objectives that the learner is to achieve. If one current TEC lesson were randomly selected from each of the lesson categories and an extremely simple version of the visuals was produced, a series of studies could be conducted that would provide conclusive evidence on the types of lessons in which simple art is equal or superior to complex art. If this proposed program of research yielded results for different types of TEC lessons similar to that which Dwyer obtained in his research, the application of these findings could bring about substantial saving in future production costs plus increase in lesson effectiveness.

Table 2

Analysis of Covariance Summary

Source Variation	DF	Post-Score MS	Post-Score F	Visual Score MS	Visual Score F	Gen. Att. Score MS	Gen. Att. Score F	Art Att. Score MS	Art Att. Score F
Total	78	131.60		13.53		12.44		14.02	
Method (Simple vs complex)	1	14.17	.198	.927	.0817	14.688	1.143	20.615	1.488
Time (AM vs. PM)	1	67.25	.941	33.076	2.916	.634	.0493	16.882	1.219
Method * Time	1	50.69	.709	8.560	.755	1.423	.111	5.207	.376
Covariates	2	2512.4	35.146	88.947	7.842	6.397	.498	18.01	1.300
GTS	1	127.72	1.787	18.07	1.593	12.283	.956	.749	.0541
Pre-Score	1	3194.07	44.682	173.18	15.268	5.171	.402	31.937	2.306
Error	73	71.48		11.343		12.847		13.851	

Table of Unadjusted and Adjusted Means		Simple	Complex	Simple	Complex	Simple	Complex	Simple	Complex
		41.250	41.050	10.350	10.900	26.150	25.400	34.200	35.850
Time	AM	41.922	39.453	10.439	10.885	26.138	25.541	34.248	35.794
		41.750	42.420	12.450	11.579	26.650	25.526	35.700	36.211
	PM	42.179	42.942	12.417	11.535	26.591	25.452	35.704	36.215

Table 3

Differences in Response Patterns on Attitude Items Between Subjects Completing Simple and Complex Lessons

Item	Chi Square	Level of Significance	Notes
1. Do you feel the lesson did a good job in helping you learn?	4.50	NS	Favors simple treatment (5.99 needed for .05 alpha)
2. Did the pictures focus your attention on the guns and materials the lesson was talking about? (Check one)	.20	NS	
3. Were the pictures incomplete or too sketchy. In other words, do you feel the pictures should contain more detail so that you know what is being talked about?	6.76	NS	Favors complex treatment (9.49 needed for .05 alpha)
4. Do you feel the pictures had too much detail?	2.26	NS	
5. How does this lesson compare to a Field Manual?	.54	NS	
6. If there were more lessons like this on other subjects, would you like to take them?	5.56	NS	Favors simple treatment (7.81 needed for .05 alpha)
7. Some pictures draw human figures in great detail, showing insignia, correct colors and physical details such as fingernails, etc. Which one of the following best describes the lesson you have just completed?	1.82	NS	
8. Do you think the amount of details in the pictures had any effect on how much you learned? (Check one)	2.46	NS	
9. The picture showing the unity power window of the commanders periscope in this lesson was not drawn in detail. Do you believe that drawing equipment with more detail would help you learn better? (Check one)	1.19	NS	

Table 3 (cont.)

Item	Chi Square	Level of Significance	Notes
10. Did you find any mistakes on the pictures or sound?	5.0	.05	Favors simple treatment
11. Did you have any problem understanding which parts of the machineguns the pictures were referring to?	4.44	NS	Favors complex treatment (5.99 needed for .05 alpha)
12. How well did the pictures represent parts of the machinegun?	5.03	NS	Favors complex treatment (5.99 needed for .05 alpha)
13. In your opinion, how well did this lesson teach you the lesson objectives?	.17	NS	
14. Have you ever seen an Army training film? If yes, how would you compare this lesson to a typical Army Training film?	.11	NS	
15. What did you like least about this lesson?	.99	NS	
16. How would you improve the lesson you just received?			Free response item.
17. What did you like best about this lesson?	4.41	NS	

*NS indicates "not significant". For Chi Square values that approach significance, alpha level needed to reach .05 level of significance is given.

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